

PROGRESS REPORT

Period of 1 June 1965 to 30 June 1965

CONTRACT NUMBER AF33(600)40280

BY

WESTINGHOUSE ELECTRIC CORPORATION

AEROSPACE DIVISION

Box 746, Baltimore, Maryland 21203

TABLE OF CONTENTS

A.	F-101 Flight Test	3
	Flight Tests	3
	Modifications and Ground Tests	5
B.	System	6
	Low Noise Receiver Pre-Amplifier	6
	Motion Compensation	7
	Antenna	7
C.	Spares	8
D.	Correlator Operation	8
E.	Correlator Design Review	9
	Appendix A - Summary of Flights	10

A. F-101 FLIGHT TEST

Flight Tests

Five radar missions were accomplished during June, as indicated in the program summary in Table I. Primary purposes of the flights were linear receiver evaluation and radar interpretation data from a ship anchored in Baltimore Harbor and army vehicles at Aberdeen Proving Ground.

Flight 169 was the last in the series using the linear receiver, with a corner reflector pattern at Bolling Field as the primary target. Difficulties on the next flight prevented direct comparison of the limiting amplifier with the linear receiver.

Ten radar passes were made against the "Ciudad de la Habana" a freighter anchored in Baltimore Harbor, at 0° , 45° , 90° , 315° , and 270° headings relative to the ship and for down-look angles of 24° and 38° .

TABLE I
F-101 PROGRAM SUMMARY
June 1965

Flights Scheduled		14
Flights Accomplished		5
Radar	5	
Flights Cancelled		9
Recorder	1	
Receiver	1	
Power Supply	1	
Weather	3	
Aircraft	3	
In-flight Failures		1
Power Supply	1	

Radar returns have not been constant over the full range for the flights at 22,500 feet altitude. Near range returns were less than normal, indicating incorrect positioning of the antenna elevation pattern relative to the recorded range sweep. Range mark timing and transmitter delay (1 usec) were measured relative to the same synchronizing pulse and found satisfactory. A map with more uniform return was obtained by flying at 21,000 feet altitude to effectively shift the antenna pattern.

Appendix A summarized the individual flights in June.

All radar data was recorded at low altitude. However, the aircraft was flown to 40,000 feet on three flights to perform after-burner engine tests. A Pratt and Whitney representative has visited Westinghouse as a consultant and recommended further engine work to correct the deficiency and permit high altitude, supersonic missions. Failures of the radar operator's oxygen regulator and aircraft altitude indicator and a skin fracture that occurred during flight 172 have been corrected.

Personnel from Hill AFB in Ogden, Andrews AFB, and Wright-Patterson AFB met at Westinghouse to review the IRAN and Tech Order status on the F-101. Four T.O.'s were considered critical:

- (1) T.O. 847 Wing Skin Doubler
- (2) T.O. 859 Speed Brake and High Q Fence
- (3) T.O. 921 Rivets in Wing Rear Spar
- (4) T.O. 951 Heat and Vent Ducts

In order to maintain maximum aircraft availability for the contract, Hill AFB people will fabricate ducting and supply a crew to perform these depot level T.O.'s at Westinghouse in July.

Modifications and Ground Tests

Receiver

After completing the linear receiver tests with flight 169, the second IF amplifier was reconverted to the normal limiting configuration.

During the flight 171 pre-flight, a change in noise level and receiver oscillations were noted when the transmitter was on. Retuning the Par-Amp and changing the Par-Amp bias filtering corrected the trouble.

A Tunnel Diode Amplifier failure was reported in the May progress report. The TR tube was replaced at the same time as the TDA module and returned to the manufacturer for testing. The TR tube was found to have a cracked window which increased the transmitter leakage power into the TDA, causing the TDA failure.

Transmitter

An intermittent overload developed during the 174 pre-flight. To expedite flying, transmitter 001 was replaced by the breadboard transmitter, which provided a 32 nano-second pulse and 40 watts average power.

Recorder

The improved electronics package with higher reliability and faster switching in the flip-flop circuits has been flown for the last four flights with satisfactory results. The CRT blanking circuitry was modified at the same time to shorten the cathode return lead.

Post-flight tests following 169 indicated a decrease in CRT light output and a change in the recorder transfer characteristic.

Recorder 006 replaced 005 in the F-101. The recorder bias vs. film transmission curve for this CRT is very steep over the desired linear operating region, causing the bias adjustment to be quite critical, as evidenced by the maps of flights 171 and 172 against the ship.

The high voltage power supply was unsynchronized intermittently during flight 169 causing a change of focus. In addition, a 6U8 failed in the dynamic focus circuit.

Recorder 006 now in the F-101 has satisfactory CRT focus, but the trace focus on the capstan is out of adjustment. Because of this maladjustment and the greater vibration noise in recorder 006, recorder 005 will be returned to the F-101 prior to the next flight.

Power Supply

An arcing fuse-holder and a shorted Zener diode were replaced in one of the +150 volt power supplies during the pre-flight for 171. The shorted Zener caused a voltage overload and damage to a transistor in the film drive inverter.

Forward Look System

Data from the forward look system was recorded for the second time on flight 173. Receiver gain was inadequate for proper operation.

B. SYSTEM

Low Noise Receiver Pre-Amplifier

The Par-Amp installation for the two deliverable units has been delayed another six weeks. The delay imposes no problem, since the Phase II flight test is inactive until October.

Motion Compensation

Tests on the modified integrator unit were completed. Results showed the gain and phase shift to be the same as the original design, while the resonant period of the ringing was increased less than 10 per cent. However, the overshoot in response to a step function was reduced significantly:

	Modified Unit	Unmodified Unit
Overshoot in High Gain, First Maximum	5.2 volts	7.5 volts
Second Maximum	0.83 volts	3.3 volts

This improvement will be added to all units, including the integrator used in the F-101.

Antenna

Investigation into possible solutions to the antenna sealing problem is continuing along several paths.

Westinghouse Research Labs have achieved excellent bonds of fabric on nickel strips with heat, pressure and no adhesive. However, bonding to the waveguide sticks has been more difficult because of non-uniform pressure along the bonding surface. Two successful bonds have been made and are being tested.

Research Labs are also working on a wet overlay bond, in which a glass fabric saturated with resin is laid on the waveguide sticks and cured and then overcoated with successive layers of resin, which are cured in sequence. This has been unsuccessful to date because of the formation of bubbles in the bond line and air leakage through the fabric at room temperatures.

In tests at Aerospace, I40 and I66 resin was used to bond the fabric to waveguide as Doryl had been used. One sample out of three for each type of resin survived 6 hours at heat and pressure; one of these sticks later held 70 psi pressure at room temperature.

The remaining sticks developed leaks in the bond line during heat-pressure tests. Except for a few local spots, adhesion was exceptionally strong, indicating a problem in cleaning the sticks. Tests showed that the vapor degreasing and ultrasonic cleaning in hot tri-clorethylene did not leave the surface clean. Electro-chemical etch should replace the ultrasonic cleaning.

No additional testing of the Doryl resin is planned because of non-uniformity and lack of control on the resin.

Vacuums of 10^{-4} mm of mercury were attained on an antenna module (16 sticks). Because of the encouraging results with the I40 and I66 resin bonding techniques, this technique will be discontinued for now.

C. SPARES

One item - TR tube - was added to Amendment 11 of the system spares exhibit. Status of spares is as follows:

	Items Shipped	Items Open	Per Cent Complete
System	1	15	99
Basic list plus first 10 amendments	1	9	99
Amendment 11 (remains open)	0	6	--
Ground Support Equipment	3	1	99

D. CORRELATOR OPERATION

The best correlated map to date was obtained from flight 168 in the Washington, D. C. area.

A series of test correlations was run to determine if the narrow slit above the wedge interference filter could be located to eliminate extra images caused by inter-reflections. As a result, the slit has been relocated.

Work with the Detail Correlator continued. Two plane-convex cylinders were added to the enlarging system which normally provides a 4.4 to 1 aspect ratio. The added lens enlarged the range dimension approximately 4 times, while relaying the azimuth information, to provide a 1 to 1 aspect. Since they are simple lenses, field curvature is still a problem. Achromatic doublets have been ordered to improve this.

Several targets from many flights have been correlated on the Detailer for interpretation work and study.

E. CORRELATOR DESIGN REVIEW

Further delays have been encountered with the information for the design review report.

APPENDIX A

Flight No.	169	170	171
Date	6-2-65	6-14-65	6-22-65
Altitude	22500	21000	21000
Area	Washington, D.C.	Washington, D.C.	Baltimore Harbor
Purposes	After-burner checks; receiver linearity tests with corner reflector targets	After-burner checks; IF limiting tests with corner reflector targets; Altitude change for antenna pattern test.	Multiple runs against an anchored ship.
Significant System Changes	11.4 db less RF gain than flight 166	Limiting receiver; recorder 006; modified recorder electronics package.	None
Results	4 runs were made at varying IF gain -5, 10, 15, and 20 db. Run 4 with 5 db appears best. Targets in D.C. Stadium parking lot scaled 15-18 ft. Run 3 with 10db was good in the strong target areas but fair in low level contrast. Other 2 runs are weak. On all runs, attenuation due to antenna pattern present at near range. Some divergent clutter was present.	Run 1 - Antenna servo not on, Run 2 - recorder not turned on. Run 3 - Stalo failed. No good data obtained.	Incorrect bias on CRT produced very weak map. Recorrelation at 1/8 speed produced much more detail, but contrast still below average. Anchored ship plus dredge and piping showed well on both detail and dynamic correlation.

SPECIAL HANDLING

-10-

SPECIAL HANDLING

APPENDIX A

Flight No.	172	173	
Date	6-22-65	6-29-65	
Altitude	21000	21000	
Area	Baltimore Harbor	Aberdeen Proving Ground	
Purposes	Multiple runs against anchored ship.	After-burner checks; data from army vehicles at Aberdeen Proving Ground	
Significant system Changes	None	New attenuator pad in limiting IF amplifier.	
Results	Incorrect bias on CRT produced very weak map. Recorrelation at 1/3 speed produced much more detail, but contrast still below average. Anchored ship plus dredge and piping showed well on both detail and dynamic correlation.	Map good in best areas. Contrast fair. Resolution 20-30 ft. Vehicles, reflectors, etc. detected. Poor DFT tracking caused some fading. Divergent clutter due to antenna position in some areas.	

SPECIAL HANDLING

-11-

SPECIAL HANDLING